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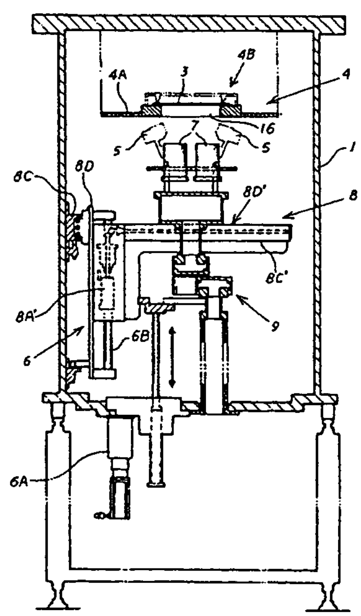
最終頁に続く

(54)【発明の名称】蒸着装置

(57)【要約】
【課題】真空槽の中にＸ，Ｙ駆動機構あるいはＸ－θ駆動機構あるいはＸ－Ｚ駆動機構など複数方向に蒸着源を移動する蒸着源移動機構を設け、蒸着源と基板との距離を近くしても、蒸発源を基板面に沿って、例えばＸ方向Ｙ方向に移動させて蒸着することで膜厚分布を一定とすることができると共に、基板以外に材料が飛ぶ量を少なくし材料の使用効率を向上できる画期的な蒸着装置を提供すること。
【解決手段】減圧雰囲気とする蒸着室１内に設けた固定部４に基板３を固定し、蒸着源７より発生する成膜材料が基板３上に堆積して薄膜が形成されるように構成した蒸着装置において、前記蒸着源７をＸ，Ｙ，Ｚ，θ方向などの異なる複数方向に若しくはこれら複数方向の合成方向に移動させる蒸着源移動機構８を設けて、この蒸着源移動機構８により蒸着時に前記蒸着源７を前記基板３に対して移動させるように構成した蒸着装置。
【選択図】　図１



【特許請求の範囲】
【請求項１】
減圧雰囲気とする蒸着室内に設けた固定部に基板を固定し、蒸着源より発生する成膜材料が基板上に堆積して薄膜が形成されるように構成した蒸着装置において、前記蒸着源をＸ，Ｙ，Ｚ，θ方向などの異なる複数方向に若しくはこれら複数方向の合成方向に移動させる蒸着源移動機構を設けて、この蒸着源移動機構により蒸着時に前記蒸着源を前記基板に対して移動させるように構成したことを特徴とする蒸着装置。
【請求項２】
前記蒸着源移動機構は、固定側に対して移動側がガイド部と駆動部との組み合わせにより前記所定方向に駆動移動するように構成し、この移動側に前記蒸着源を固定して、蒸着源を前記所定方向に移動制御するように構成したことを特徴とする請求項１記載の蒸着装置。
【請求項３】
前記蒸着源を前記所定方向に移動する前記蒸着源移動機構の駆動部を制御して、前記蒸着源の移動速度を制御し得るように構成したことを特徴とする請求項１，２のいずれか１項に記載の蒸着装置。
【請求項４】
前記蒸着源は取付傾斜角度を調整自在に構成し、この蒸着源の蒸発中心が前記基板上の一点に合うように調整固定し得るように構成したことを特徴とする請求項１～３のいずれか１項に記載の蒸着装置。
【請求項５】
前記蒸着源に膜厚センサー若しくはモニターを配設して、前記蒸着源移動機構により前記蒸着源と共に移動して常に膜厚レートを測定若しくはモニターして蒸着状況を把握できるように構成したことを特徴とする請求項１～４のいずれか１項に記載の蒸着装置。
【請求項６】
前記蒸着源移動機構の移動側に複数の前記蒸着源を設けて、二元蒸着若しくは多元蒸着し得るように構成したことを特徴とする請求項１～５のいずれか１項に記載の蒸着装置。
【請求項７】
少なくとも前記基板の面方向に対する前記蒸着源移動機構による前記蒸着源の移動距離を、前記基板の寸法より大きく設定したことを特徴とする請求項１～６のいずれか１項に記載の蒸着装置。
【請求項８】
前記蒸着源移動機構に前記基板と前記蒸着源との距離を調整する蒸着距離調整機構を設けたことを特徴とする請求項１～７のいずれか１項に記載の蒸着装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、例えば基板にＥＬ材料を蒸着して成膜しＥＬ表示装置を作製する蒸着装置に関するものである。
【０００２】
【従来の技術及び発明が解決しようとする課題】
例えば有機ＥＬを作製する際、真空化した蒸着室（真空槽）内でＥＬ材料をガラス基板に蒸着する場合には、従来は低位置に置かれた点蒸発源（蒸着源）から材料を蒸発させて基板上に堆積させ薄膜を形成させるが、膜厚分布を一定にするために、蒸発源と基板との距離は長くせざるをえない。従って、蒸着源はこのように基板の中心から離れた位置に置かれているためガラス基板以外に材料が飛ぶ量が多く、材料の使用効率が悪い。
【０００３】
本発明は、真空槽の中にＸ，Ｙ駆動機構あるいはＸ－θ駆動機構あるいはＸ－Ｚ駆動機構など複数方向に蒸着源を移動する蒸着源移動機構を設け、蒸着源と基板との距離を近くしても、蒸発源を基板面に沿って、例えばＸ方向Ｙ方向に移動させて蒸着することで膜厚分

布を一定とすることができると共に、基板以外に材料が飛ぶ量を少なくし材料の使用効率を向上できる画期的な蒸着装置を提供することを目的としている。

【0004】

【課題を解決するための手段】

添付図面を参照して本発明の要旨を説明する。

【0005】

減圧雰囲気とする蒸着室1内に設けた固定部4に基板3を固定し、蒸着源7より発生する成膜材料が基板3上に堆積して薄膜が形成されるように構成した蒸着装置において、前記蒸着源7をX，Y，Z，θ方向などの異なる複数方向に若しくはこれら複数方向の合成方向に移動させる蒸着源移動機構8を設けて、この蒸着源移動機構8により蒸着時に前記蒸着源7を前記基板3に対して移動させるように構成したことを特徴とする蒸着装置に係るものである。

【0006】

また、前記蒸着源移動機構8は、固定側に対して移動側がガイド部と駆動部との組み合わせにより前記所定方向に駆動移動するように構成し、この移動側に前記蒸着源7を固定して、蒸着源7を前記所定方向に移動制御するように構成したことを特徴とする請求項1記載の蒸着装置に係るものである。

【0007】

また、前記蒸着源7を前記所定方向に移動する前記蒸着源移動機構8の駆動部を制御して、前記蒸着源7の移動速度を制御し得るように構成したことを特徴とする請求項1，2のいずれか1項に記載の蒸着装置に係るものである。

【0008】

また、前記蒸着源7は取付傾斜角度を調整自在に構成し、この蒸着源7の蒸発中心が前記基板3上の一点に合うように調整固定し得るように構成したことを特徴とする請求項1～3のいずれか1項に記載の蒸着装置に係るものである。

【0009】

また、前記蒸着源7に膜厚センサー若しくはモニター5を配設して、前記蒸着源移動機構8により前記蒸着源7と共に移動して常に膜厚レートを測定若しくはモニターして蒸着状況を把握できるように構成したことを特徴とする請求項1～4のいずれか1項に記載の蒸着装置に係るものである。

【0010】

また、前記蒸着源移動機構8の移動側に複数の前記蒸着源7を設けて、二元蒸着若しくは多元蒸着し得るように構成したことを特徴とする請求項1～5のいずれか1項に記載の蒸着装置に係るものである。

【0011】

また、少なくとも前記基板3の面方向に対する前記蒸着源移動機構8による前記蒸着源7の移動距離を、前記基板3の寸法より大きく設定したことを特徴とする請求項1～6のいずれか1項に記載の蒸着装置に係るものである。

【0012】

また、前記蒸着源移動機構8に前記基板3と前記蒸着源7との距離を調整する蒸着距離調整機構6を設けたことを特徴とする請求項1～7のいずれか1項に記載の蒸着装置に係るものである。

【0013】

【発明の実施の形態】

好適と考える本発明の実施の形態（発明をどのように実施するか）を、図面に基づいてその作用効果を示して簡単に説明する。

【0014】

例えば、真空化する蒸着室1内の固定部4（ホルダー）に基板3を固定し、蒸着源7から発生する成膜材料が基板3上に堆積して薄膜を形成する。

【0015】

この際、蒸着源７は、固定されているのではなく、蒸着時には蒸着源移動機構８により前記基板３に対して移動する。即ち、蒸着源７は蒸着源移動機構８により基板３に沿ってくまなく移動しながら成膜材料を蒸発させ、基板３上に薄膜を形成する。

【００１６】

この蒸着源移動機構８は、蒸着源７を設ける移動側を固定側に対してＸ，Ｙ，Ｚ，θ方向などの異なる複数方向に移動自在に設け、順次これら複数方向へ移動させるか、これらの合成方向に移動させることで、基板３に沿ってくまなく移動するように移動制御（移動ルートを設定）することで、基板３との距離が短くても均一に薄膜を形成できることとなる。

【００１７】

従って、例えば基板３の板面を水平面方向とし、これの二軸方向となるＸ，Ｙ方向、あるいは回転方向となるθ方向、又は基板３を水平配置せずに垂直配置とした際、この面方向の二軸となるＸ，ＺあるいはＹ，Ｚ方向あるいは回転方向となるθ方向に移動自在に設け、前記板面に沿って移動側を移動制御して蒸着源７を移動しながら蒸着を行なうことで、たとえ基板３と蒸着源７との距離を短くしても、基板３に対して蒸着源７をくまなく移動させながら蒸着することができるため、膜厚が片寄らず均一な膜を形成することができ、また基板３外へ無駄に材料が飛ぶ量を少なくでき、よって膜厚を一定にでき、且つ材料の使用効率を向上させることができることとなる。

【００１８】

また、蒸着源７の移動速度を制御することで精度の良い膜厚分布を実現でき、また蒸着源７の取付角度を調整して蒸着源７の蒸発中心を基板３上の一点に合うようにセットすることで、一層前記作用・効果を良好に発揮させることができる。

【００１９】

また、蒸着源７に膜厚センサーやモニター５を配設すれば、蒸着源移動機構８により蒸着源７と共にこの膜厚センサーやモニター５を常に一緒に移動制御でき、常に各カ所での膜厚レートを測定あるいは蒸着状況を把握できるため、一層膜厚の均一化を図れ、移動制御の精度も向上できる。

【００２０】

また、複数の蒸着源７を蒸着源移動機構８により一緒に移動するように構成することも容易で、この場合には例えばホスト蒸着源７とドーパント蒸着源７を並べて移動することで精度の高い二元蒸着やその他同様にして多元蒸着も可能となる。

【００２１】

また、蒸着距離調整機構６により適切な距離に基板３と蒸着源７を調整設定できるようにすれば、状況に応じてできるだけ基板３と蒸着源７との距離を短くして、均一化と材料使用効率の向上を一層図れることとなる。

【００２２】

【実施例】

本発明の具体的な実施例について図面に基づいて説明する。

【００２３】

図１に示すように、真空ポンプにより真空化する蒸着室１内に配設した固定部４にガラス基板３を固定する構成としている。この固定部４の下部に設けたホルダー４Ａは、蒸着用開口部１６を有する枠状構成とし、この蒸着用開口部１６をおおうようにガラス基板３を位置決め載置し、この端部に設けた固定機構４Ｂによりガラス基板３を上方から押圧してホルダー４Ａ上に押圧固定する構成としている。

【００２４】

また、この蒸着室１内底部に設けた蒸着源７より発生する成膜材料が固定部４の蒸着用開口部１６から露出している基板３上に堆積して薄膜が形成されるように構成している。

【００２５】

本実施例では、前記蒸着源７をＸ，Ｙ，Ｚ，θ方向などの異なる複数方向に同時に移動させることでこれら複数方向の合成方向に移動できる蒸着源移動機構８を設けて、この蒸着

源移動機構８により蒸着時に前記蒸着源７を前記基板３に対してこの基板面に沿って移動させるように構成している。

【００２６】

本実施例では、基板３を固定部４により蒸着室１内に水平配置し、この下側の蒸着室１の底部側に４つの蒸着源７を設け、この蒸着源７を一斉に水平方向となる前記基板面に沿って蒸着源移動機構８により自動的にこの板面方向で移動するように構成している。

【００２７】

即ち、水平方向の互いに直交する二軸となるＸ方向とＹ方向、又はこの双方若しくはその一方向と水平回転方向であるθ方向との二方向若しくは三方向に蒸着源７が移動自在となるように蒸着源移動機構８を構成するが、本実施例では、図４に示すようにＸ方向とＹ方向に移動自在となるように構成し、順次これら複数方向へ移動するように制御することで、Ｘ方向，Ｙ方向の移動（平面より見て、たて，よこ，たて，よこの移動）を繰り返して、基板３の板面に沿ってジグザグに移動して、基板３の板面をくまなく移動するように構成している。

【００２８】

具体的には、この蒸着源移動機構８は、図１，図２に示すように、固定側（蒸着室１に対して固定する部材）に対して移動側がガイド部と駆動部との組み合わせにより前記所定方向に駆動移動するように構成し、この移動側に前記蒸着源７を固定して、蒸着源７を前記所定方向に移動制御するように構成している。

【００２９】

例えば、回転駆動源８Ａによってボールネジ８Ｂを回転させ、ＬＭガイド８Ｃに沿って移動体８Ｄをボールネジ８Ｂに沿って移動させるように構成し、この移動体８Ｄに前記ボールネジ８Ｂと直交する方向にボールネジ８Ｂ’を配設してこのボールネジ８Ｂ’を回転駆動源８Ａ’によって駆動することでＬＭガイド８Ｃ’に沿って移動体８Ｄ’を移動させるように構成し、この移動体８Ｄ’を移動側として蒸着源７を設けることで、上下に配して互いに直交する方向のボールネジ８Ｂ，８Ｂ’をＸ，Ｙ方向とし、各ボールネジ８Ｂ，８Ｂ’の回転量を順次制御することで、予め設定したＸ，Ｙ方向に蒸着源７を移動するように構成している。尚、水平回動支点を設けてθ方向にロボットアームなどにより移動するように構成しても良い。

【００３０】

また、蒸着室１に対して固定する固定板を固定側とし、この固定板に対して移動する移動テーブルを移動側とし、固定板と移動テーブルとの間にガイド部と駆動部とを有するモジュールを複数設け（θ方向に移動させる場合には、水平回動支点部を設け）、各モジュールを駆動制御することで移動テーブルがＸ，Ｙ（及びθ）方向に移動制御される薄偏平形の移動機構を蒸着室１底部に構成し、このＸ，Ｙ方向に移動する移動テーブルに蒸着源７を設けるように構成しても良い。

【００３１】

また、基板３を垂直方向に配する場合には、この蒸着源移動機構８も同様に垂直方向で平面的に（Ｘ，ＺあるいはＹ，Ｚあるいはθ方向との組み合わせにより）移動するように構成しても良い。

【００３２】

また、本実施例では更にＺ方向に移動自在として立体自由に移動させて基板３との距離も調整されるように構成している。

【００３３】

具体的には、本実施例では立体的に移動制御はしないが、蒸着源移動機構８を昇降駆動源６Ａと昇降ガイド６ＢとによってＺ方向に昇降自在に設けて、前記蒸着距離調整機構６を構成し、基板３の大きさや蒸着材料あるいは蒸着状況に応じてこの蒸着距離調整機構６により基板３と蒸着源７との距離を調整設定し、できるだけ基板３と蒸着源７との距離を短くして、均一化と材料使用効率の向上を一層図れるように構成している。

【００３４】

また、例えば、前述のようにＸ，Ｙ方向の移動を組み合わせるのではなく、図５，図６に示すようにθ方向の組み合わせによる複合旋回方式に蒸着源移動機構８を構成しても良い。

【００３５】
従って、予め蒸着距離調整機構６により基板３と蒸着源７とをできるだけ短い距離に設定し、また予めこの蒸着源移動機構８の駆動を制御する制御部の移動ルート設定により、蒸着源７はこの移動ルート通りに移動あるいは繰り返し移動させることができ、また基板３の変更や蒸着材料の変更、基板３と蒸着源７との距離の調整などによってこの移動ルートを変更設定できるようにしている。

【００３６】
尚、蒸着室１底部外と蒸着源移動機構８の移動部分内部とを連通して大気とし、移動制御されてもこの連通状態が保持される移動連通保持機構９を備え、この移動連通保持機構９を介して、エア，水，電気などをフレキシブル配管などで蒸着源７に供給する構成としている。

【００３７】
例えば、図５，図６に示すように駆動源８Ｅによって基板３と平行に水平回動方向（θ１方向）に駆動制御される水平アーム８Ｆに、駆動源８Ｇによって更に水平回動方向（θ２方向）に駆動制御される水平アーム８Ｈを枢着し、この水平アーム８Ｈに駆動源８Ｉによって水平回動方向（θ３）に駆動制御される水平板８Ｊを設け、この水平板８Ｊに蒸着源７を設け、この各水平アーム８Ｆ，８Ｈ，水平板８Ｊのθ１，θ２，θ３方向の複合回動制御によって、駆動源７が基板３の板面に沿ってくまなく所定ルートを移動するように構成しても良い。

【００３８】
また、本実施例では前記基板３の板面方向に対する前記蒸着源移動機構８による前記蒸着源７の移動距離（範囲）を、前記基板３の寸法よりやや大きく設定している。

【００３９】
これにより、基板３の端部での薄膜の均一化も図れ、できるだけ基板３外へ無駄に材料が飛ぶ量を少なくできる。

【００４０】
また、前記蒸着源７を前記所定方向に移動する前記蒸着源移動機構８の駆動部を制御して、前記蒸着源７の移動速度を制御し得るように構成している。この速度制御は、各駆動部の出力調整や出力伝達機構の切り替えによって減速・増速できるようにしている。

【００４１】
また、前記蒸着源７は、図３に示すように取付構造を介して着脱自在に設け、容易に取り替え可能とし、またこの取付構造による取付傾斜角度を調整自在に構成し、この各蒸着源７の蒸発中心が前記基板３上の一点に合うように調整固定できるように構成している。

【００４２】
従って、たとえ複数の蒸着源７を配設しても、この各蒸着源７の蒸着中心が蒸発中心の移動ルートの一点上に合うようにセットできるため、常にバラツキなく一定の膜厚の蒸着が効率良く良好に行なうこととなる。

【００４３】
また、前記蒸着源７に膜厚センサーあるいは蒸着監視用のモニター５を配設して、前記蒸着源移動機構８により前記蒸着源７と共に移動して常に膜厚レートを測定したり、蒸着状況を把握できるように構成している。

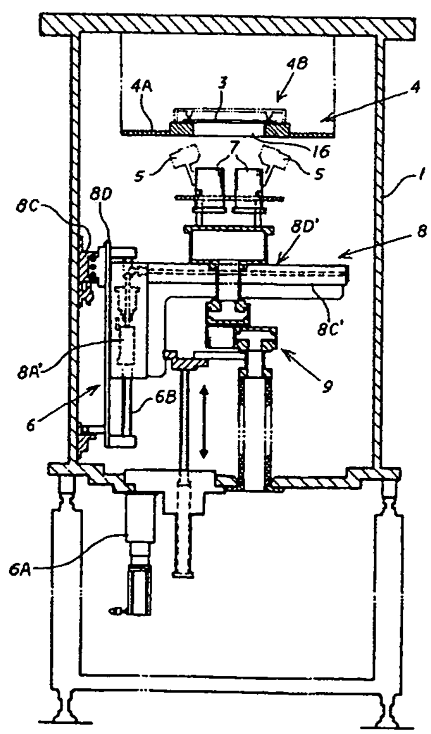
【００４４】
また、前記蒸着源移動機構８の移動側に複数の前記蒸着源７を設けて、複数の蒸着源７がこの蒸着源移動機構８により常に一緒に同一ルートを移動できるように構成することが容易に実現できるため、二元蒸着や多元蒸着も良好に行なえることとなる。

【００４５】
この際、各蒸着源７を前述のようにいずれも同様に角度調整設定し、共に蒸発中心を基板

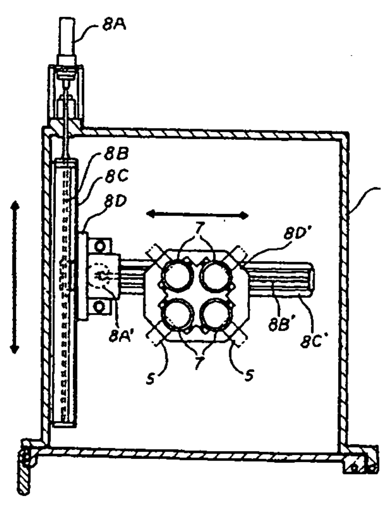
3上の一点に合うように取付固定できるようにしているため、一層良好に精度の高い二元蒸着や多元蒸着が行なえる。
【0046】
また、蒸着源7にモニター5を配設し、蒸着源7と共に移動するように構成し、このモニター5も蒸発中心が合う基板3上の一点を向くように取り付けるようにすることで、蒸着状況を常に監視しながら蒸着を行なえ、一層秀れた蒸着装置となる。
【0047】
従って、蒸着源移動機構8の移動側に複数の蒸着源7やセンサー，モニター5などを適宜適切な向きにして交換取付できる取付部2を設けることで極めて実用性に秀れた蒸着装置となる。
【0048】
尚、本発明は、本実施例に限られるものではなく、各構成要件の具体的構成は適宜設計し得るものである。
【0049】
【発明の効果】
本発明は上述のように構成したから、蒸着室の中に例えばX，Y駆動機構あるいはX－θ駆動機構あるいはX－Z駆動機構など複数方向に蒸着源を移動する蒸着源移動機構を設け、蒸着源と基板との距離をたとえ近くしても、蒸発源を基板面に沿って、例えばX方向Y方向に移動させて蒸着することで膜厚分布を一定とすることができると共に、基板以外に材料が飛ぶ量を少なくし材料使用効率を向上できる画期的な蒸着装置となる。
【0050】
また、請求項2記載の発明においては、一層容易に実現でき、一層実用性に秀れた蒸着装置となる。
【0051】
また、請求項3記載の発明においては、蒸着源の移動速度を制御することで精度の良い膜厚分布を実現できることとなる。
【0052】
また、請求項4記載の発明においては、蒸着源の取付角度を調整して蒸着源の蒸発中心を基板上の一点に合うようにセットすることで、一層前記作用・効果を良好に発揮させることとなる。
【0053】
また、請求項5記載の発明においては、蒸着源に膜厚センサーやモニターを配設すれば、蒸着源移動機構により蒸着源と共にこの膜厚センサーやモニターを常に一緒に移動制御でき、常に各カ所での膜厚レート測定あるいは蒸着状況を把握できるため、一層膜厚の均一化を図れ、移動制御の精度も向上できることとなる。
【0054】
また、請求項6記載の発明においては、複数の蒸着源を蒸着源移動機構により一緒に移動するように構成することも容易で、この場合には例えばホスト蒸着源とドーパント蒸着源を並べて移動することで精度の高い二元蒸着やその他同様にして多元蒸着も可能となることとなる。
【0055】
また、請求項7記載の発明においては、基板の端部での薄膜の均一化も図れ、できるだけ基板外へ無駄に材料が飛ぶ量を少なくできることとなる。
【0056】
また、請求項8記載の発明においては、適切な距離に基板と蒸着源を調整設定でき、できるだけ基板と蒸着源との距離を短くして、均一化と材料使用効率の向上を一層図れることになる一層秀れた蒸着装置となる。
【図面の簡単な説明】
【図1】本実施例の概略構成説明正面図である。
【図2】本実施例の概略構成説明平面図である。

【図３】本実施例の蒸着源７の取付部を示す拡大説明正面図である。
【図４】本実施例の蒸着時の移動ルートの一例を示す説明図である。
【図５】本実施例の蒸着源移動機構８の別例を示す概略構成説明正断面図である。
【図６】本実施例の蒸着源移動機構８の別例を示す概略構成説明平面図である。
【符号の説明】
1　蒸着室
3　基板
4　固定部
5　モニター
6　蒸着距離機構
7　蒸着源
8　蒸着源移動機構

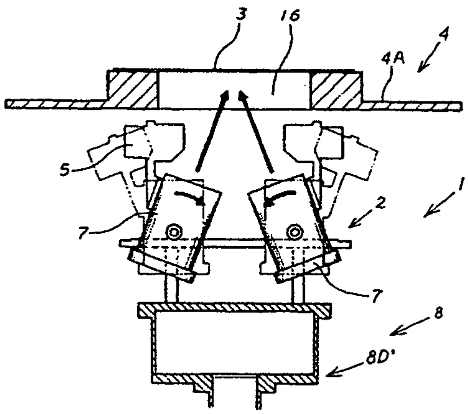
【図１】



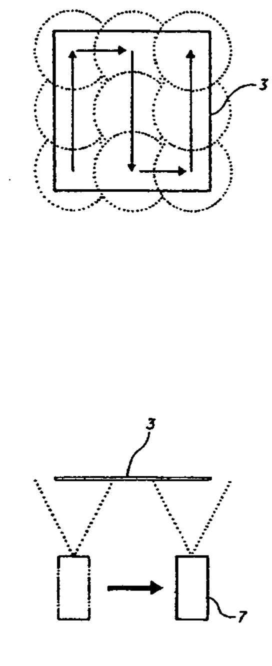
【図２】



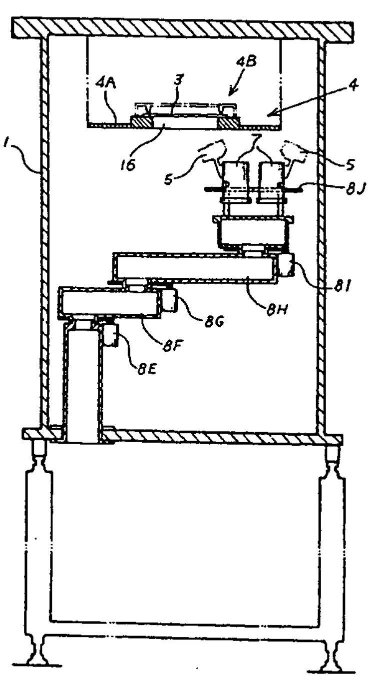
【図３】


3
16
4
4A
5
1
2
7
7
8
8D'

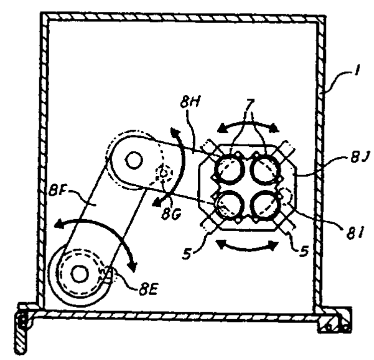
【図４】


3
3
7

【図５】


4A
3
4B
4
1
16
5
7
5
8J
8I
8G
8H
8F
8E

【図６】


8H
7
1
8J
8F
8G
8I
5
5
8E

フロントページの続き

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Continued on the last page

(54) [Title of the Invention]

EVAPORATION DEVICE

(57) [ABSTRACT]

[Object]

An object of the present invention is to provide an innovative evaporation device, wherein an evaporation source moving mechanism for moving an evaporation source in the plural directions such as a X or Y driving mechanism, a X-θ driving mechanism and a X-Z driving mechanism is provided in a vacuum chamber; when a distance between the evaporation source and a substrate is shortened, a film having uniform thickness can be obtained by performing the evaporation while moving a vaporization source along the surface of the substrate, e.g., in the X direction and the Y direction; and the amount of material that is scattered out of the substrate can be reduced to improve the material use efficiency.

[Solving Means]

In an evaporation device, a substrate 3 is fixed to a fixed portion 4 which is provided in an evaporation chamber 1 under reduced-pressure atmosphere, and a material for forming a film that is supplied from an evaporation source 7 is accumulated over the substrate 3 to form a thin film. In this evaporation device, an evaporation source moving mechanism 8 for moving the evaporation source 7 in the different plural directions such as X, Y, Z and θ directions or in the composite direction thereof is provided, and the evaporation source 7 is moved with respect to the substrate 3 when performing the evaporation by using the evaporation source moving mechanism 8.

[Selected Drawing] FIG. 1

[CLAIMS]

[Claim 1]

An evaporation device, in which a substrate is fixed to a fixed portion provided inside of an evaporation chamber where reduced pressure atmosphere is maintained and a material for a film that is supplied from an evaporation source is accumulated over a substrate to form a thin film, characterized in that an evaporation source moving mechanism for moving the evaporation source in different plural directions such as X, Y,

Z and θ directions or in a composite direction thereof is provided, and the evaporation source is moved with respect to the substrate by the evaporation source moving mechanism when performing the evaporation.

[Claim 2]

The evaporation device according to claim 1, wherein the evaporation source moving mechanism is provided such that a mobility side is moved in the predetermined direction with respect to a fixed side by a combination of a guide portion and a driver portion, the evaporation source is fixed at the mobility side, and the evaporation source is controlled to be moved in the predetermined direction.

[Claim 3]

The evaporation source according to claim 1 or claim 2, wherein a moving rate of the evaporation source is controlled by controlling the drive portion of the evaporation source moving mechanism that moves the evaporation source in the predetermined direction.

[Claim 4]

The evaporation source according to any one of claims 1 to 3, wherein a fitting tilt angle of the evaporation source is freely adjusted and fixed such that a vaporization center of the evaporation source locates to one point over the substrate.

[Claim 5]

The evaporation source according to any one of claims 1 to 4, wherein a film thickness sensor or monitor is provided in the evaporation source, and a film thickness rate is always measured or monitored to determine an evaporation situation by moving the film thickness sensor or monitor together with the evaporation source using the evaporation source moving mechanism.

[Claim 6]

The evaporation device according to any one of claims 1 to 5, wherein a plurality of evaporation sources are provide at the mobility side of the evaporation source moving mechanism so that a two-dimensional evaporation or a multi-dimensional evaporation can be performed.

[Claim 7]

The evaporation device according to any one of claims 1 to 6, wherein a moving distance of the evaporation source with respect to a surface direction of the substrate that is moved by the evaporation source moving mechanism is set larger than a size of the substrate.

[Claim 8]

The evaporation device according to any one of claims 1 to 7, wherein an evaporation distance adjustment mechanism for adjusting a distance between the substrate and the evaporation source is provided in the evaporation source moving mechanism.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention, for example, relates to an evaporation device by which an EL material is evaporated to a substrate and a film is formed to manufacture an EL display device.

[0002]

[Description of the Prior Art and Problem to be solved by the invention]

For example, when manufacturing an organic EL, in the case where an EL material is evaporated to a glass substrate in a vacuumized evaporation chamber (a vacuum chamber), the EL material is conventionally evaporated from a spot vaporization source (an evaporation source) which is positioned at a lower position and accumulated over the substrate to form a thin film. However, in order to make the film thickness uniform, a distance between the vaporization source and the substrate must be lengthened. Thus, since the evaporation source is positioned apart from the center of the glass substrate in such a manner, a large amount of material is scattered out of the glass substrate, which results in bad material use efficiency.

[0003]

It is an object of the present invention to provide an innovative evaporation device, wherein an evaporation source moving mechanism for moving an evaporation source in the plural directions such as an X or Y driving mechanism, an X-θ driving

mechanism and an X-Z driving mechanism is provided in a vacuum chamber, even if a distance between the evaporation source and a substrate is shortened, a film thickness distribution can be kept uniform by evaporating a material while moving an vaporization source in an X direction and a Y direction, and the amount of material scattered out of the substrate can be reduced so as to improve the material use efficiency.

[0004]

[Means for Solving the Problem]

The subject-matter of the present invention will be described referring to the accompanying drawings.

[0005]

In an evaporation device, a substrate 3 is fixed to a holding portion 4 which is formed in an evaporation chamber 1 where reduced-pressure atmosphere is maintained and a thin film is formed over the substrate 3 by accumulating a material for the film that is supplied from an evaporation 7. An evaporation source moving mechanism 8 by which the evaporation source 7 is moved in different plural directions such as X, Y, Z and θ directions, or in the composite direction of these plural directions is formed. The evaporation source 7 is moved with respect to the substrate 3 by this evaporation source moving mechanism 8 when evaporation is performed.

[0006]

The evaporation device according to claim 1 is characterized in that the evaporation source moving mechanism 8 is provided such that the mobility side is driven and moved in the predetermined direction with respect to the fixed side by a combination of a guide portion and a drive portion, and the evaporation source 7 is fixed to be moved in the predetermined direction.

[0007]

The evaporation device according to claim 1 or claim 2 is characterized in that the drive portion of the evaporation source moving mechanism 8 for moving the evaporation source 7 in the predetermined direction is controlled to control the moving speed of the evaporation source 7.

[0008]

The evaporation device according to any one of claims 1 to 3 is characterized in that a fitting tilt angle of the evaporation source 7 is freely adjusted and fixed such tat a vaporization center of the evaporation source 7 matchs with one point over the substrate 3.

[0009]

The evaporation device according to any one of claims 1 to 4 is characterized in that a film thickness sensor or monitor 5 is provided at the evaporation source 7 to move with the evaporation source 7 by the evaporation source moving mechanism 8 so that an evaporation situation can always be determined by measuring or monitoring the film thickness rate.

[0010]

The evaporation device according to any one of claims 1 to 5 is characterized in that the plural evaporation sources 7 are provided at the mobility side of the evaporation source moving mechanism 8 so that the binary evaporation or the multiple evaporation can be performed.

[0011]

The evaporation device according to any one of claims 1 to 6 is characterized in that a moving distance of the evaporation source 7 with respect to the surface of the substrate 3, which is moved by the evaporation source moving mechanism 8, is set to be at least larger than a dimension of the substrate 3.

[0012]

The evaporation device according to any one of claims 1 to 7 is characterized in that an evaporation distance adjustment mechanism 6 which adjusts a distance between the substrate 3 and the evaporation source 7 is provided at the evaporation source moving mechanism 8.

[0013]

[Embodiment Mode of the Invention]

The preferred embodiment mode of the present invention (how to implement the present invention) will be briefly described showing the effect with reference to the

drawings.

[0014]

For example, a substrate 3 is fixed to a holding portion 4 (a holder) inside of a vacuumized evaporation chamber 1 and a material for forming a film that is supplied from an evaporation source 7 is deposited over the substrate 3 so as to form a thin film.

[0015]

In this case, an evaporation source 7 is not fixed. When the evaporation is performed, the evaporation source 7 is moved with respect to the substrate 3 by an evaporation source moving mechanism 8. In other words, while the evaporation source 7 is moved all along the substrate 3 by the evaporation source moving mechanism 8, the material is vaporized to form a thin film over the substrate 3.

[0016]

Even if a distance between the evaporation source 7 and the substrate 3 is short, a thin film can be uniformly formed by providing the evaporation source moving mechanism 8 as follows. A mobility side of the evaporation source moving mechanism to which the evaporation source 7 is set is provided to be freely moved in the different plural directions such as X , Y, Z and θ directions with respect to a fixed side, and by sequentially moving the mobility side in the plural directions or in a composite direction of these plural directions, the mobility of the evaporation source 7 is adjusted such that the evaporation source 7 is moved all along the substrate (a moving route is set).

[0017]

Therefore, for example, when the surface of the substrate 3 is provided in the horizontal direction, the mobility side is provided to be freely moved in the X and Y directions of a two-axes direction of this surface or in the θ direction that is a rotation direction. Alternatively, when the surface of the substrate 3 is provided in the perpendicular direction rather than the horizontal direction, the mobility side is provided to be freely moved in the X and Z or Y directions of a two-axes direction of the surface or in the θ direction that is a rotation direction. By performing the evaporation while controlling the movement of the mobility side to move the evaporation source 7 along

the surface of the substrate, even if the distance between the substrate 3 and the evaporation source 7 is shortened, the evaporation can be performed while moving the evaporation source 7 all along the substrate 3. Therefore, a film having a uniform thickness can be formed. In addition, the amount of a material that is wastefully scattered out of the substrate 3 can be reduced, and the uniformity in thickness can be achieved, making it possible to improve the material use efficiency.

[0018]

In addition, a high-accurate film thickness distribution can be realized by controlling the moving speed of the evaporation source 7. In addition, the effective action and effect can be further achieved by controlling a fitting angle of the evaporation source 7 and setting a vaporization center of the evaporation source 7 to correspond to one point over the substrate 3.

[0019]

If a film thickness sensor or monitor 5 is provided in the evaporation source 7, the movement of the film thickness sensor or monitor 5 can be always controlled together with the evaporation source 7 by the evaporation source moving mechanism 8. Thus, the film formation rate in respective portions can always be measured or the evaporation situation can be always checked by the film thickness sensor or monitor so that the uniformity in film thickness can be achieved, making it possible to improve the accuracy of the movement control.

[0020]

Further, plural evaporation sources 7 are easily provided such that the plural evaporation sources are moved together by the evaporation source moving mechanism 8. In this case, for example, it is also possible to perform a highly accurate binary evaporation or a multiple evaporation in the same manner by moving a host evaporation source 7 along with a dopant evaporation source 7.

[0021]

When a distance between the substrate 3 and the evaporation source 7 can be adjusted suitably by an evaporation distance adjustment mechanism 6, the distance between the substrate 3 and the evaporation source 7 can be shortened, and the

uniformity of the film thickness can be further achieved and the material use efficiency can be further improved.

[0022]

[Embodiment]

A specific embodiment of the present invention will be described with reference to the drawings.

[0023]

As shown in FIG. 1, a glass substrate 3 is fixed to a fixed portion 4 which is provided in an evaporation chamber 1 vacuumized by a vacuum pump. A holder 4A which is provided under the fixed portion 4 has a frame-like structure that has an opening portion 16 for evaporation. The glass substrate 3 is positioned and placed to cover the opening portion 16 for evaporation. The glass substrate 3 is pressed from above by a fixed mechanism 4B which is provided in an edge portion and is fixed to the glass substrate 3 over the holder 4A.

[0024]

Also, a material for forming a film that is supplied from evaporation sources 7 provided at the bottom of the evaporation chamber 1 is accumulated over the substrate 3 that is exposed from the opening portion 16 for evaporation of the fixed portion 4 so as to form a thin film.

[0025]

In this embodiment, an evaporation source moving mechanism 8 is provided, wherein by simultaneously moving the evaporation sources 7 in the different plural directions such as X, Y, Z and θ directions, the evaporation sources 7 can be moved in a composite direction of these plural directions. By this evaporation source moving mechanism 8, the evaporation sources 7 can be moved along the surface of the substrate 3 when performing the evaporation.

[0026]

In this embodiment, the substrate 3 is arranged horizontally in the evaporation chamber 1 by the fixed portion 4. And four evaporation sources 7 are provided at the bottom of the evaporation chamber 1 under the substrate. All of the evaporation

sources 7 are automatically moved in the direction of the surface of the substrate along the surface of the substrate that is placed horizontally.

[0027]

That is to say, the evaporation source moving mechanism 8 is provided such that the evaporation sources 7 are freely moved in the horizontal X direction and the Y direction that are two axes being orthogonal to each other or two or three direction of one or both of the X and Y directions and the θ direction that is the horizontal rotating direction. In this embodiment, the evaporation source moving mechanism 8 is provided such that the evaporation sources are freely moved in the X direction and the Y direction. By controlling the evaporation sources such that the evaporation sources are sequentially moved in the plural directions, the movement in the X direction and the Y direction (i.e., a perpendicular and horizontal movement seem from the top surface) is repeated, and the evaporations sources are moved all along the surface of the substrate 3 in a zig-zag manner.

[0028]

Specifically, this evaporation source moving mechanism 8 is provided such that the mobility side is driven and moved in the predetermined direction with respect to the fixed side (a material which is fixed to the evaporation chamber 1) by a combination of a guide portion and a drive portion as shown in FIG. 1 and FIG. 2. The evaporation sources 7 are fixed to the mobility side and the movement of the evaporation sources 7 is controlled in the predetermined direction.

[0029]

For example, a ball screw 8B is spun by a spin drive source 8A and a movable body 8D is moved along an LM guide 8C and the ball screw 8B. A ball screw 8B' is provided in the movable body 8D in a direction perpendicular to the ball screw 8B. The movable body 8D' is moved along the LM guide 8C' by driving this ball screw 8B' by a spin drive source 8A'. By providing the evaporations sources 7 to the movable body 8D' as the mobility side, the ball screws 8B and 8B', which are orthogonal to each other, are set to be in the X and Y directions. Also, by sequentially controlling the spin amount of each of the ball screws 8B and 8B', the evaporations sources 7 are moved in

the predetermined X and Y directions. Alternatively, a horizontal turning fulcrum point may be provided and the evaporations sources 7 may be moved in the θ direction by a robot arm and the like.

[0030]

A fixed plate which is fixed to the evaporation chamber 1 is the fixed side. A moving table which moves with respect to the fixed plate is the mobility side. Plural modules having a guide portion and a drive portion between the fixed plate and the moving table are provided (in the case where the moving table is moved in the θ direction, a horizontal turning fulcrum portion is provided). A movement mechanism having a thin flatness form in which the moving table is controlled to be moved in the X and Y (and θ) directions by controlling the respective modules is provided at the bottom of the evaporation chamber 1. The evaporation sources 7 may be provided on the moving table which move in the X direction and the Y direction.

[0031]

In addition, when the substrate 3 is provided in the perpendicular direction, this evaporation source moving mechanism 8 may also be moved in the perpendicular direction and in the planar manner (by a combination of the Z direction and the X or Y direction, or a combination of the Z direction or the θ direction).

[0032]

In the present embodiment, a distance between the evaporation sources and the substrate 3 is further adjusted by freely moving the evaporations source moving mechanism in the Z direction, or, by freely moving it in all three dimensions.

[0033]

Specifically, in the present embodiment, although the movement control is not performed three dimensionally, the evaporation source moving mechanism 8 is provided to be freely moved up and down in the Z direction by a lifting drive source 6A and a lifting guide 6B and the evaporation distance adjustment mechanism 6 is provided. The distance between the substrate 3 and the evaporation sources 7 is controlled and set by the evaporation distance adjustment mechanism 6 in accordance with the size of the substrate 3, an evaporation material and an evaporation situation. The distance

between the substrate 3 and the evaporation sources 7 is shortened as much as possible so that the uniformity can be achieved and the material use efficiency can be improved.

[0034]

In addition, for example, the evaporation source moving mechanism 8 may be provided to be of a combined turning system with a combination of the θ directions as shown in FIGS. 5 and 6, instead of a combination with the X and Y directions as described above.

[0035]

Thus, the distance between the substrate 3 and the evaporation sources 7 is set as short as possible by the evaporation distance adjustment mechanism 6 previously. The evaporation sources 7 can be moved once or more times in accordance with the moving route setting of a control portion in advances that controls the drive of the evaporation source moving mechanism 8. This moving route can also be changed by changing the substrate 3 and the evaporation material and by controlling the distance between the substrate 3 and the evaporation sources 7 and the like.

[0036]

In addition, a movement communicating retention mechanism 9, by which the out of a lower section of the evaporation chamber 1 is in communication with an inner portion of a moving section of the evaporation source moving mechanism 8, is provided so that the atmospheric air is maintained in the evaporation source moving mechanism 8. Even when the movement is controlled, this communicating situation is kept by the movement communicating retention mechanism 9. Air, water, electricity and the like are supplied to the evaporation sources 7 by a flexible tube and the like through the movement communicating retention mechanism 9.

[0037]

For example, as shown in FIG. 5 and FIG. 6, a horizontal arm 8F which is controlled in the horizontal turning direction (in the θ1 direction) in parallel with the substrate 3 by a drive source 8E is mounted with a horizontal arm 8H which is controlled in the horizontal turning direction (in the θ2 direction) by a drive source 8G. A horizontal plate 8J which is controlled in the horizontal turning direction (θ3) by a

drive source 8I is provided on the horizontal arm 8H. The evaporation sources 7 are provided on the horizontal plate 8J. By controlling the combined turning movement of the respective horizontal arms 8F, 8H and the horizontal plate 8J in the θ1, θ2 and θ3 directions, the evaporation sources 7 may be moved through the predetermined route all along the surface of the substrate 3.

[0038]

Moreover, in the present embodiment, a moving distance (range) of the evaporation sources 7 with respect to the surface direction of the substrate 3, which is moved by the evaporation source moving mechanism 8, is set slightly larger than the size of the substrate 3.

[0039]

Consequently, the uniformity of a thin film at the edge of the substrate 3 can be achieved and the amount of a material, which is wastefully scattered out of the substrate 3, can be reduced as much as possible.

[0040]

A drive portion of the evaporation source moving mechanism 8 by which the evaporation sources 7 are moved in the predetermined direction is controlled and the moving speed of the evaporation sources 7 can be controlled. This speed control can slow down and speed up by switching an output control and an output transmission mechanism of each of the drive portions.

[0041]

Further, the evaporation sources 7 are freely attached and removed through the fitting structure as shown in FIG. 3 and they can be easily replaced. Also, by freely adjusting the fitting tilt angle by this fitting structure, the vaporization center of each evaporation source can be adjusted and fixed to correspond to one point over the substrate 3.

[0042]

Thus, even when the plural evaporation sources 7 are provided, since the evaporation center of each evaporation source 7 can be set to correspond to one point on the moving route of the vaporization center, the evaporation can be performed

efficiently to form a film having constant and uniform thickness.

[0043]

By providing a film thickness sensor or a monitor 5 for monitoring evaporation at the evaporation sources 7, the film thickness sensor or the monitor for monitoring evaporation is moved with the evaporation sources 7 by the evaporation sources moving mechanism 8, making it possible to always measure the film thickness rate or determine the evaporation situation.

[0044]

In addition, the plural evaporation sources 7 are provided at the mobility side of the evaporation source moving mechanism 8, and the plural evaporation sources 7 can be easily moved together by the evaporation source moving mechanism 8 along the same route, and therefore, the two-dimensional evaporation or the multi-dimensional evaporation can be carried out favorably.

[0045]

In this case, since the angle of each evaporation source 7 is adjusted in the same manner as described above and each evaporation source 7 is fixed such that the vaporization center corresponds to one point over the substrate 3, highly-accurate two-dimensional evaporation or multi-dimensional evaporation can be further favorably performed.

[0046]

Also, the monitor 5 is provided in the evaporation sources 7 such that the monitor 5 is moved along with the evaporation sources 7. By providing the monitor 5 to face one point over the substrate 3 where the vaporization center corresponds to the one point, the evaporation can be performed while the monitor constantly monitors the evaporation situation, thereby providing a further excellent evaporation device.

[0047]

Therefore, by providing a fitting portion 2 to which the plural evaporation sources 7, the sensor, the monitor 5 and the like can be arbitrarily attached for replacement so as to face a suitable direction, an extremely practical evaporation device can be obtained.

[0048]

Furthermore, the present invention is not limited to this embodiment, and the specific structure of the composite requirement can be arbitrarily designed.

[0049]

[Effect of the Invention]

As set forth above, an innovative evaporation device can be manufactured in accordance with the present invention, wherein, for example, an evaporation source moving mechanism for moving an evaporation source in the plural direction such as an X or Y driving mechanism, an X-θ driving mechanism and an X-Z driving mechanism is provided in an evaporation chamber, and even when a distance between the evaporation source and a substrate is shortened, a film having an uniform thickness can be formed by performing the evaporation while moving the evaporation source along the surface of the substrate, for example, in the X direction and the Y direction. In addition, the amount of a material that is scattered out of the substrate can be reduced, thereby improving the material use efficiency.

[0050]

In accordance with claim 2 of the present invention, the evaporation device that can be easily realized and is superior in practical use can be obtained.

[0051]

In accordance with claim 3 of the present invention, a film having extremely uniform thickness can be achieved by controlling the moving rate of the evaporation source.

[0052]

In according with claim 4 of the present invention, the above described function and effect can be further exhibited by adjusting the fitting angle of the evaporation source such that a vaporization center of the evaporation source corresponds to one point over the substrate.

[0053]

In according with claim 5 of the present invention, when a film thickness sensor or a monitor is provided in the evaporation source, the movement of the film

thickness sensor or the monitor can be always controlled along with the evaporation source by the evaporation source moving mechanism. Since the film thickness rate can be measured or the evaporation situation can be determined at several points, the uniformity in film thickness can be further realized, thereby improving the accuracy of movement control.

[0054]

In accordance with claim 6 of the present invention, plural evaporation sources can be easily moved together by the evaporation source moving mechanism. In this case, for instance, by moving a host evaporation source and a dopant evaporation source together, a two-dimensional evaporation or a multi-dimensional evaporation can be performed precisely.

[0055]

Further, in accordance with claim 7 of the present invention, the uniformity of film thickness can be realized at the edge of a substrate and the amount of a material that is wastefully scattered out of the substrate can be reduced as much as possible.

[0056]

Furthermore, in accordance with claim 8 of the present invention, a distance between a substrate and an evaporation source can be adjusted suitably. By shortening the distance between the substrate and the evaporation source as much as possible, the uniformity in film thickness can be further realized and the material use efficiency can be further improved. This results in an excellent evaporation device.

[Brief Description of Drawings]

[FIG. 1] A front view which explains a schematic structure of the present embodiment.

[FIG. 2] A plain view which explains a schematic structure of the present embodiment.

[FIG. 3] An enlarged front view which shows a fitting portion of an evaporation source 7 of the present embodiment.

[FIG. 4] An explanation view of the present embodiment which shows an example of a moving route when an evaporation is performed.

[FIG. 5] A cross-sectional view which shows an another example of an evaporation source moving mechanism 8 of the present embodiment.

[FIG. 6] A plain view which shows an another example of an evaporation source moving mechanism 8 of the present embodiment.

[Explanations of the Letters of numerals]

1: evaporation chamber

3: substrate

4: fixed portion

5: monitor

6: evaporation distance mechanism

7: evaporation source

8: evaporation source moving mechanism

Continuation of the front page

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